PRELIMINARY Health Assessment for

WEST LAKE LANDFILL

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

CERCLIS NO. MODO79900932

OCTOBER 4, 1991

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

The conclusion and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

PRELIMINARY HEALTH ASSESSMENT

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Prepared by

Missouri Department of Health

Under Cooperative Agreement with the

Agency for Toxic Substances and Disease Registry

SUMMARY

The West Lake Landfill, located in the City of Bridgeton, St. Louis County, Missouri, was proposed for the National Priorities List (NPL) in October 1989. Soil contaminated with radioactive waste from decontamination efforts at the Cotter Corporation's Latty Avenue plant in Hazelwood, Missouri, was dumped at the landfill in 1973. The radioactive soil was used as cover over refuse and in later years the radioactive soil itself was covered with additional soil and debris. The area around the landfill consists mostly of industrial buildings and business offices with small residential communities to the south and east. Agricultural river bottom land borders to the west, but it is fast being encroached upon by Earth City which is being developed for commercial purposes. The site presents no apparent public health hazard because the available data indicate human health is not currently being affected. Exposures of concern could occur if ground water contamination increases and spreads, exposed radioactive materials on the northwestern edges of the landfill move off site, or on-site worker exposure increases. Continued monitoring is recommended until additional environmental data is available to assess the on-site and off-site contamination and help predict future activity.

BACKGROUND

A. Site Description and History

The West Lake Landfill is a 200 acre tract located in the City of Bridgeton, St. Louis County, Missouri (Fig. 1). The tract borders St. Charles Rock Road on the northeast side and Old St. Charles Rock Road on the southwest. It is northwest of Interstate 270 and about 4 miles west of the Lambert-St. Louis International Airport. The tract was owned in its entirety by West Lake Properties from 1939 to 1988. In 1988, most of the tract was sold to Laidlaw Industries; however, West Lake Properties retained the two radioactively contaminated areas through a subsidiary named Rock Road Industries. Laidlaw Industries operates the landfill under a Missouri Department of Natural Resources (MDNR) permit.

From 1939 to 1987, limestone was quarried at the site. In 1962, landfill operations commenced using old quarry pits to receive municipal refuse, industrial waste, and construction debris. Also located on the property is an active industrial complex producing concrete ingredients and aggregates. The landfill is located on the historical edge of the Missouri River alluvial valley, with about 75 percent of the site being located in the floodplain. Soils at the demarcation line vary from Missouri River alluvium to upland loessal soil. The present channel of the Missouri River lies just under 2 miles west of the landfill. The floodplain area and new businesses/industries being constructed there are protected by a flood control levee. The ground water level in the Missouri River floodplain is generally within 10 feet of the surface. The reported flow is to the northwest from the site toward the Missouri River.

In 1973, approximately 43,000 tons of soil contaminated with barium sulfate residues containing about 7 tons of uranium and its radioactive decay products were placed in the landfill. The radioactive material consists primarily of uranium (U-238), thorium (Th-230), and radium (Ra-226). The soil came from decontamination efforts at the Cotter Corporation's Latty Avenue plant in Hazelwood where the material had been stored. In 1980-81, The Radiation Management Corporation (RMC), under contract to the Nuclear Regulatory Commission (NRC), conducted a detailed radiological survey of the West Lake Landfill. Material was found to have been dumped in two areas (Fig. 2). Area 1 is located near the landfill main office and covers approximately 3 acres. It contains about 20,000 cubic yards of radioactive contaminated soil buried about 3 to 5 feet deep. It is located over a former quarry pit which was previously filled with debris. Area 2 covers about 13 acres and lies above 16 to 20 feet of debris. The radioactive contaminated soil forms a layer from 2 to 15 feet thick consisting of approximately 130,000 cubic yards. Some of this contaminated soil is at or near the surface, particularly along the face of the northwestern berm.

In 1983-1984, the University of Missouri-Columbia (UMC) Department of Civil Engineering, under contract to the NRC, further characterized the site and evaluated potential remedial measures. In 1986, Oak Ridge Associated Universities (ORAU) sampled well water on and close to the landfill to determine if radioactive material had migrated into the ground water. Based

on the reports of these studies, the site was proposed for inclusion on the National Priorities List (NPL) in 1989.

B. Site Visit

On March 21, 1990, representatives of the Missouri Department of Health (DOH), the Agency for Toxic Substances and Disease Registry (ATSDR), Environmental Protection Agency (EPA), and MDNR visited the West Lake Landfill site. The president of West Lake Properties led a tour of the area. He showed the group the two areas with radioactive contamination and reviewed the history and current operations at the site.

It was noted during the site visit that the entire facility is now fenced, a security project completed in 1989. Before the fencing, employees present during working hours and security guards present after working hours helped prevent unauthorized access. The two areas of radioactive contamination were not readily identifiable or marked. Area 2 did have a temporary row of barrels to indicate the approximate eastern boundary. The only persons having regular access to the area are the site's work force.

During the time of the visit, the weather was clear and it had not rained for a few days. Area 1 had a few small puddles of standing water and good vegetative ground cover with no obvious erosion problems. Area 2 had no vegetative ground cover, but had a variety of soil and crushed limestone cover. Drainage was good with the ground being dry except in the northernmost end where some water had pooled. Some recent dumping of apparent construction debris was being used to fill in the low area where the water was standing.

Physical hazards at the site consisted of discarded construction equipment and miscellaneous construction debris. After the NPL site visit, a driving tour was conducted of the surrounding off-site area to determine possible routes of exposure, demographics of the area, land use, and the possible population at risk.

C. Demographics, Land Use, and Natural Resource Use

The West Lake Landfill is located in the northwestern portion of the City of Bridgeton, in St. Louis County, Missouri. Earth City Industrial Park is located on the floodplain approximately 1 mile west of the landfill. Population density on the floodplain is generally less than 26 persons per square mile; the daytime population (including factory workers) is much greater than the number of full-time residents.

Major highways in the area include Interstate 70 (I-70) and Interstate 270 (I-270), which meet south of the landfill. The Earth City Expressway and St. Charles Rock Road lie, respectively, west and east of the landfill. The Norfolk and Western Railroad passes about 1/2 mile from the northern portion of the landfill. Lambert-St. Louis International Airport is located approximately 4 miles east of the West Lake Landfill.

In addition to business/industries at Earth City, plants are operated by Ralston-Purina and Hussman Refrigeration across St. Charles Rock Road. The

employees of these two plants probably comprise the largest group of individuals in close proximity to the contaminated areas for significant periods of time. Considering that land in this area is relatively inexpensive and that much of it is zoned for manufacturing, industrial development on the floodplain will likely increase in the future.

Two small residential communities are present near the West Lake Landfill. Spanish Lake Village consists of about 90 homes and is located about 1 mile south of the landfill, and a small trailer court lies across St. Charles Rock Road, 1 mile southeast of the site. Subdivisions are presently being developed 2 miles east and southeast of the landfill in hills above the floodplain. Ten or more houses lie east of the landfill scattered along Taussig Road. The City of St. Charles is located on the west bank of the Missouri River about 2 miles from the landfill.

Areas south of the West Lake Landfill are zoned residential; areas on the other sides are zoned for manufacturing and business. Most of the landfill is zoned for light manufacturing (M-1). However, some of the northern portion of the landfill is zoned for residential use; this includes the contaminated area around the former Butler-type building site in Area 2. The field northwest of the landfill between Old St. Charles Rock Road and St. Charles Rock Road is under cultivation. Trends indicate that the population of this area will increase, but the land will probably be used primarily for business/industrial facilities.

No public water supplies are drawn from the alluvial aquifer near the West Lake Landfill. It is believed that only one private well in the vicinity of the landfill is used as a drinking water supply. In 1981, analysis showed water in this well to be fairly hard (natural origins), but otherwise of good quality.

Water supplies are drawn from the Missouri River at mile 29 for the City of St. Charles, and the intake is located on the north bank of the river. Another intake at mile 20.5 is for the St. Louis Water Company's North County plant.

The City of St. Louis takes water from the Mississippi River, which joins the Missouri River downstream from the landfill. In this segment of the river, the two streams have not completely mixed and the water derived from the Missouri River is still flowing as a stream along the west bank of the Mississippi River channel. Reportedly, the intake structures for St. Louis are on the west bank of the river so that the water drawn may or may not be mixed, depending on conditions.

D. State and Local Health Data

The Missouri Department of Health, State Center for Health Statistics, analyzes and consults on health related information collected from several sources. The Center's Bureau of Health Data Analysis has available statistical information, hospital discharge data, and the Multi-Source Birth Defect Registry. The Multi-Source Birth Defect Registry consists of birth outcome data from the following data sources: birth, death, hospital

discharge, Crippled Children's Services, and Neonatal Intensive Care Unit records.

For health assessments, cancer mortality rates by age, sex, and cancer site are calculated to determine whether there is a significant difference between the area of concern and the rest of the State. Birth data include fetal deaths, low birth weight births, and frequency of malformations in the area of concern with comparison to the State rate.

For most of the State, the smallest geographic area that can be studied is defined by a zip code. In the St. Louis metropolitan area, census tract information is available that allows further refinement of the potentially exposed population. However, that may still represent a larger area than is actually affected by a site such as West Lake Landfill and the additional people in the study group may well dilute and obscure any adverse health outcomes, if present.

COMMUNITY HEALTH CONCERNS

Community concern around the area seems to be minimal. The Missouri Department of Health (DOH) has had contact with area residents through the DOH private well water monitoring program. The residents have expressed interest in the results of the water sampling, but have expressed no particular health concerns. Newspaper articles have been published about the site and its possible hazards and public concern about this site may increase in the future because of its link to three radioactive waste sites near the St. Louis airport. The three sites - Futura Coating Company, Hazelwood Interim Storage, and St. Louis Airport - have been consolidated and listed on the NPL as the St. Louis Airport/HIS/Futura Coating Site. These sites have generated considerable interest and debate including involvement of a local environmental group. Their interest may extend to West Lake as the radioactive waste there came from the St. Louis sites.

A. Public Comment Response

In order to solicit public comment on the West Lake Landfill Preliminary Health Assessment, the document was made available to the public as required under the Missouri Department of Health cooperative agreement with ATSDR.

The Health Assessment was placed at four readily accessible repository sites (City of Bridgeton, City Hall; Bridgeton Trails Branch, St. Louis County Library; Murphy Health Center; and the St. Louis County Department of Community Health and Medical Care) for a period of 30 days (April 29 - May 29, 1991).

Notification of the availability of the Preliminary Health Assessment was in the form of a news release on April 23, 1991, followed by two public notices in the Sunday St. Louis Post Dispatch on May 5, 1991, and May 19, 1991. No comments were received during the public comment period for the West Lake Landfill Preliminary Health Assessment.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. On-Site Contamination

In 1980-81, a radiological survey of the West Lake Landfill was conducted by the Radiation Management Corporation (RMC) of Chicago, Illinois. External (gamma) radiation levels in microrems per hour (-R/Hr) were measured 1 meter above the ground surface. This survey showed the radioactive contaminants to be located in two areas of the landfill (Fig. 2). Both areas had places that exceeded 100 -R/Hr with a maximum level as high as 3,000 to 4,000 -R/Hr detected in Area 2. The total areas exceeding 20 -R/Hr were about 2 acres in Area 1 and 9 acres in Area 2. Levels were again measured in May (Fig. 2) and in July of 1981 and found to be significantly lower than the November 1980 sampling, especially in Area 1 where approximately 4 feet of sanitary fill had been added. An equal amount of construction fill was added to most of Area 2. As a result, only a few hundred square meters of Area 1 exceeded 20 -R/Hr and the amount of Area 2 exceeding 20 -R/hr had decreased by about 10 percent with a maximum reading of about 1600 -R/hr. The 20 -R/hr criterion was derived from the NRC's Branch Technical Position, 46 CFR 52061, October 23, 1981, which aims at exposure rates less than 10 -R/hr above background levels. Background radiation in the area is about 10 -R/hr.

Surface Soil Analysis

Surface soil samples were gathered and analyzed (1980-81) on site for gamma activity. In all 61 surface soil samples, only uranium and/or thorium decay chain nuclides and K-40 (potassium 40) were detected. On-site samples ranged from about 1-21,000 picocurie per gram (pCi/gram) for Radium 226 (Ra-226) and from less than 10 to 2,100 pCi/gram Uranium 238 (U-238). Off-site background samples were on the order of 2 pCi/gram for Ra-226. In general, surface activity was limited to Area 2, with only two small regions in Area 1 showing surface contamination.

Subsurface Soil

Subsurface soil was measured by the drilling of 43 holes, with holes being drilled in known contaminated areas and then additional holes being drilled at intervals in all directions until no further contamination was detected. Concentrations of Ra-226 ranged from less than 1 pCi/gram to 22,000 pCi/gram.

Ground water

In the fall of 1980, and the spring and summer of 1981, a total of 37 water samples were taken and analyzed by RMC. One sample taken of standing water near the Butler building in Area 2 equaled the EPA drinking water standard for gross-alpha.

In 1981, MDNR collected 41 water samples that RMC analyzed for radioactivity, but only 10 were shallow ground water standing in bore holes. Of these 10 samples, only one equaled the EPA gross alpha activity standard for drinking water of 15 picocuries per liter (pCi/L). Four of the 10 shallow ground water samples exceeded 30 pCi/L gross beta activity, with most of the beta activity

coming from naturally occurring K-40 as determined from subsequent isotopic analysis. Background activity is estimated as 1.5 pCi/L gross alpha activity and 30 pCi/L gross beta activity.

In 1983, and again in 1984, eleven perimeter wells were sampled for gross alpha and gross beta. In two years of sampling, only 1 well each year exceeded the 15 pCi/L drinking water standard for gross alpha (18.2 pCi/L in 1983 NE boundary, and 20.5 pCi/L in 1984 W boundary). Only one well in 1983 exceeded 30 pCi/L gross beta activity level at 33.1 pCi/L gross beta.

In 1986 Oak Ridge Associated Universities (ORAU) personnel took water samples from 44 perimeter wells. Only one well (17 pCi/L of gross alpha activity) exceeded the drinking water standard. This well also contained 47 pCi/L gross beta activity. This well, and another at 46 pCi/L were the only ones to exceed the 30 pCi/L background gross beta activity level. These wells are close to one another on the west boundary of the landfill.

Vegetative

No elevated radioactivity was found by RMC in vegetation consisting of on-site weed samples and farm crop samples (winter wheat) located near the northwest boundary of the landfill. This crop location was chosen for sampling because water could run off from the fill onto the farm field.

Air

Concentrating on measuring radon and its daughters in the air, both gaseous and particulate airborne radioactivity were sampled and analyzed between May and August of 1981. These were sampled because of the known materials that consisted partially or totally of uranium ore residues. A total of 111 samples from 32 locations were sampled and radon flux levels ranged from 0.2 pico curie per square meter-second (pCi/m^2-sec)in low background areas to 865 pCi/m^2-sec in areas of surface contamination. A set of air particulate samples was taken to assess radon daughter concentration. Radon daughter concentration is commonly reported in terms of working level (WL), a unit of measurement originally developed for occupational exposure but also relevant and appropriate for environmental exposure. The highest levels (0.031 WL) were detected in November 1980, near and inside the Butler-type building, that has since been removed. Off-site samples were taken for background at Earth City, Taussig Road, and Old St. Charles Rock Road sites. The levels measured were reported at 0.0011, 0.005, and 0.0017, respectively.

Other Contaminants

The site has been a landfill since 1962. Prior to regulation by the MDNR, it is believed that the landfill may have accepted such materials as organics and inorganics, heavy metals, solvents, pesticides, paints and pigments, acids, bases, sewage sludge, as well as small quantities of unknown hazardous waste. This is based on notification as required by the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and may not be an accurate representation of what was actually dumped in the landfill. (A portion of CERCLA 103(c) requires owners and operators of facilities which had

stored, treated, or disposed of hazardous substance to notify the Administrator of EPA of the existence of such facilities not later than June 11, 1981. This requirement effectively obligated all owners and operators of such facilities to report the existence of facilities that they knew to have used at any time in the past for the storage, treatment or disposal of hazardous waste.) (10)

The sampling data available for the site have not demonstrated significant contamination of the ground water. Burns and McDonnell, in a 1986 report on the hydrogeology of the site, reported to have found only methylene chloride, bis (2-ethylhexyl) phthalate, and phenol in identifiable quantities in 2 rounds of sampling (December 1985 and May 1986). They also reported that the general distribution of the organic constituents was scattered and irregular. In round 2 of the sampling, the presence of methylene chloride was attributed to the laboratory process rather than to any contaminant in the ground water. In general, the detection of organics and heavy metals was scattered and irregular, leaving inconclusive evidence as to the contamination of the landfill by these materials.

B. Off-Site Contamination

Off-Site contamination from the West Lake NPL site has not been shown. The Missouri Department of Health sampled private wells in the area most likely to be contaminated. Four wells were sampled in 1988 and 1989 and no gross alpha activity above the EPA drinking water standard of 15 pCi/l was found. The samples were also tested for the presence of common pesticides. None were detected in any of the samples.

The possibility exists that during the transportation of the radioactively contaminated soil to the West Lake Landfill, some soil could have blown or spilled from the transportation trucks. This is being investigated in conjunction with the St. Louis Airport/HIS/Future Coating NPL site by a contractor for the U.S. Department of Energy.

Research of the EPA Toxic Chemical Release Inventory (TRI) was conducted to determine other chemical releases in the area of West Lake Landfill. Three industries in the vicinity reported releases in the years 1987 and 1988, two of which are within a mile of the site, while the third is just over a mile. Releases of reported chemicals had no correlation with the West Lake Landfill contamination.

C. Quality Assurance and Quality Control

Various organizations and laboratories have been involved in the sampling and analysis with varying degrees of Quality Assurance and Quality Control information available. In preparing this Preliminary Health Assessment, DOH/ATSDR have, to an extent, relied on the information provided in the referenced documents and assume adequate quality assurance and quality control measures were followed with regard to chain-of-custody, laboratory procedures, and data reporting. The validity of the analysis and therefore the conclusions drawn for this health assessment are predicated on this reliance.

D. Physical and Other Hazards

Physical hazards at the site consist of discarded construction equipment and miscellaneous waste construction debris around Area 2. The area is fenced and only workers at the site would be expected to be exposed to possible hazards.

PATHWAYS ANALYSES

As discussed in the Site Description and History Subsection, the dumping of approximately 43,000 tons of soil contaminated with barium sulfate residues containing approximately 7 tons of uranium and its radioactive decay products has polluted the West Lake Landfill.

A. Environmental Pathways (Fate and Transport)

Radioactive contaminated soil was used to cover debris and municipal waste at the West Lake Landfill. The contaminated soil has since been covered over with clean soil and remains exposed only in an area on the northwestern berm. Erosion of this soil by surface water run-off would spread radioactive contamination to the farm field west of the site and/or to the Creve Coeur Creek. The creek has no known recreational purposes and is not expected to be used for a water source. Approximately two miles downstream, the creek enters the Missouri River. Water supplies for the City of St. Charles are drawn from the opposite (north) bank of the river. The next known water intake is the St. Louis Water Company North County Plant, which is approximately 8.5 miles further downstream.

Wind erosion of dust from the berm is not expected to be a pathway of concern except in very dry conditions or during disturbance. The landfill is located on the historical edge of the Missouri River alluvial valley with about 75 percent of the site being located in the floodplain. There are two aquifiers at the site consisting of the Missouri River alluvium and the shallow limestone bedrock. Below the shallow limestone is the relatively impermeable Warsaw shale that acts as a barrier, making contamination of the deeper limestone aquifer unlikely. The shale layer has been reached by quarrying operations but has not been disturbed.

Ground water flow direction in the river floodplain varies somewhat, depending on the water level. It generally tends to flow northwest toward the river. Under high river conditions, the flow is more northerly. The ground water level is generally within 10 feet of the floodplain surface. No public water supplies are drawn from the alluvial aquifer near the West Lake Landfill. Any leachate would be significantly diluted upon reaching the alluvial ground water and further diluted once it reached the river.

The air above the contaminated soil provides a path for the dissemination of radon gas. The gas and its alpha-particle emitting daughters then become available for inhalation.

The high ratio of Th-230 to Ra-226 radioactivity indicates that decay of Th-230 will increase the concentration of its product, Ra-226, until the two radionuclides are in equilibrium. It is estimated that the Ra-226 activity will increase by a factor of nine 200 years from now, and by a factor of thirty-five 1,000 years from now. All radionuclides in the decay chain after Ra-226 (and the Ra-222 gas flux) will be increased by similar multiples. (12)

B. Human Exposure Pathways

With the landfill being fenced, direct exposure to the contaminated soil on the northwest berm to the public is not considered a viable route of exposure. If the soil was eroded from the site by either wind or water, exposure to radioactive materials could take place. Ground water in the area is not used for municipal purposes, but a few private wells in the area are used for domestic purposes and irrigation.

Surface water from the Missouri River used as a municipal supply for the City of St. Charles is not expected to be affected by the landfill. The city draws its water from the west bank where mixing has not occurred yet. The City of St. Louis Water Company North County Plant takes its water from the Missouri River at mile 20.5 where significant dilution of any possible contaminants from the landfill has already occurred.

Radon exposure to the public is not expected to be a problem since the area is fenced and there is no public access. Air levels off site would be typically much lower than on site. The possibility does exist that, in the future, increased levels of radon will be present as the material seeks equilibrium.

Ingestion of radioactive contaminants taken up by crops is not expected to be a pathway of exposure. No elevated radioactivity was detected in on-site weeds or in wheat grown near the site.

Fish from the Missouri River are not expected to be affected by the West Lake Landfill primarily due to dilution. Fish in ponds along Creve Coeur Creek west of the site may represent a potential exposure route; however, it is not known if the ponds are used for fishing. The relatively low radioactivity in the ground water in on-site monitoring wells would indicate that low activity would be likely in any connected surface waters.

PUBLIC HEALTH IMPLICATIONS

No exposure is known to be occurring to residents around the site. The few private wells in the vicinity have not shown any contamination from the West Lake Landfill; however, on-site monitoring well sampling has revealed some migration of uranium and its radioactive decay products into the ground water. The majority of the area is served by a public water system with no source wells in the area. Direct exposure of the public to ionizing radiation on site is not expected because of restricted access. Exposure to on-site workers is expected to be of small concern because the time spent in

contaminated areas is likely to be brief and can be monitored and controlled to minimize cumulative exposure.

The possibility does exist that during the unloading and disposal of the contaminated soil at West Lake, the unprotected workers could have been exposed. Information on radioactive level, worker protection, conditions during the process, times per day and the duration of the project would be needed to determine if significant exposure had occurred.

A. Toxicological Implications

Contaminants present at the landfill are Uranium-238 (U-238), Thorium-230 (Th-230), Radium-226 (Ra-226), and Radon-222 (Rn-222) with half-lives of approximately 4.5 X 10^9 years, 80,000 years, 1,600 years, and 3.8 days, respectively. These radionuclides, members of the uranium decay chain, emit alpha particles and gamma rays. At this site, the uranium, thorium and radium are nearly completely covered with clean fill so as to not present a significant direct dust inhalation or ingestion potential. Therefore, the exposures of most interest would be inhalation of radon and its daughters and ingestion of radioactively contaminated ground water. Radon gas, produced by the decay of radium, diffuses up through the soil cover and mixes with the air above it where it may be breathed. Rain falling on the soil cover percolates down into and through the contaminated layers, picks up radioactive particles, and delivers them to the ground water where they may eventually reach drinking water wells. Additionally, rain may erode contaminated soil from the northwest berm area and deposit it in the adjacent field where crop uptake is possible.

Rn-222 has been shown to be carcinogenic, producing lung cancers when inhaled, based principally on studies of uranium miners. Although radon gas itself is inert, some will be absorbed into the blood from the lungs and transported throughout the body; the rest will be exhaled. The radon decay products (daughters) are charged particles. When inhaled, either directly or attached to other airborne particulate matter, they deposit on lung surfaces and lodge in the mucosa. As the radon daughters decay, they emit alpha particles, the major health hazard associated with radon gas exposure. The alpha particles are potent ionizers, but do not travel far in tissue due to their relatively large size. (5,8)

The principal health effect of this ionizing radiation in humans is cancer induction and the most important target tissue is the bronchial epithelium. Due to their short half-life, inhaled radon daughters emit their alpha particles in the lung before they move on to other organs. Radon exposed smokers are at greatly increased risk of respiratory tract cancer due to the multiplicative interaction of the dual exposure. (8)

By convention, radon exposure is measured in terms of working levels (WL) and cumulative exposures over time are measured in working level months (WLM). One WL is defined as any combination of the short-lived radon daughters in 1 liter of air that results in the ultimate release of 1.3 x 10^5 MeV (million electron volts) of alpha particle energy. This is approximately the amount of

alpha energy emitted by the short-half-life daughters in equilibrium with 100 pCi of radon. (8)

Given that the highest level detected on site was 0.031 WL, and that this level is very close to the Nuclear Regulatory Commission (NRC) alternate concentration limit of one-thirtieth (0.033) WL for unrestricted areas (3), it does not appear that unacceptably high exposure is occurring at present. Additionally, the population at risk, on-site workers, would not experience continuous exposure at the highest level. Rather, their actual cumulative exposure would be to the weighted average of their work location levels. This average would be well below the NRC concentration limit. There is insufficient information available on the actual exposure of workers to further characterize the risk.

Since the radioactive material at the site is not a natural undisturbed deposit, the radionuclides are not in equilibrium with each other. Therefore, it is quite possible that the concentration of radon gas will increase significantly in the future. This increases the potential for future exposure.

When ingested, soluble forms of U-238 are chemically toxic to the kidney, producing tissue damage in the proximal tubules and consequent functional impairment. The tissue will regenerate and function will return if exposure ceases. This chemical toxicity is of much greater significance than the potential for ionizing radiation effects since the soluble forms are excreted from the body rather quickly. Conversely, insoluble forms may be retained in the body for a long time and the radiation effects become paramount. Target organs are principally the bone marrow and lymphatics. Exposure may result in radiation-induced cancer. (1,4)

Thorium is relatively inactive chemically and, therefore, is of concern only as a chronic radiation hazard. Little of an ingested dose of thorium is retained in the body; however, once deposited, it remains for a long time. The bones, lungs, and lymphatics are the primary depositories.

Highly radiotoxic, radium is metabolically handled the same as calcium. It is deposited in the skeleton where it serves as a source of alpha radiation in the bones and adjacent tissues. Studies of radium dial painters have clearly demonstrated excess bone cancer in heavily exposed groups. However, low exposures have shown relatively much less risk of bone cancer than would be predicted from a simple straight line extrapolation from the high exposure data. (4)

B. Health Outcome Data Evaluation

Missouri State Health Outcome Data were researched for the West Lake Landfill site in order to determine if there was an indication of common health problems associated with the area. Although little public health concern was present to warrant the research, it was useful to explore every available avenue in determining public health effects that could be present around the site. If an indicator of common health problems was found, and the problems could not be related to the site, a follow-up health study would be considered to investigate the cause.

The DOH, State Center for Health Statistics, studied cancer deaths and natality data for the years 1981-1988 for the census tracts most likely to be affected by the West Lake NPL site (Fig. 3). Using statewide cancer death rates, the expected number of deaths was calculated for the West Lake area. This number was then compared to the actual (observed) number of deaths and a test of statistical significance performed. "Statistical significance" means that any noted difference between the two numbers is probably not due just to chance. Cancer deaths were looked at by type of cancer for various age groups, for all types combined for age groups, and for total cancer deaths for all age groups combined. Cancer of the kidney in the 45-64 age group was the only comparison that achieved statistical significance. There were 3 observed deaths in this group when less than 1 would have been expected. Small numbers like this, however, may not allow meaningful analysis and it is unknown if these persons actually experienced any exposure.

Fetal deaths and low birth weight weights (less than 2,500 grams) were studied for years 1981-1988. The observed number of fetal deaths was not significant compared to the expected value. The number of observed low birth weight weights for the site area was significantly lower than expected.

Based on the State rate, a study of 1981-1986 births did not reveal an observed number of anomalies significantly different from those expected. This study was based upon aggregated birth and death certificates, hospital discharge, Crippled Children's Service, and neonatal intensive care unit data.

These studies neither confirm nor deny a health threat to the population potentially at risk from the West Lake Landfill. The census tracts located between the Missouri River and Highway 270 in north St. Louis County, (the smallest definable area for these studies), include a much larger geographical area and larger population than would actually be affected by this site; therefore, any adverse health effects might be obscured.

CONCLUSIONS

From the information reviewed, the West Lake Landfill is presently judged to be of no apparent public health hazard. No exposures above applicable levels of concern are known to be presently occurring or to have occurred in the past. The only suspected exposure at a level of concern would have been to unprotected workers during past disposal of radioactively contaminated soil at the site.

The relatively low levels of radioactive contamination in the ground water suggest that the radionuclides present in the landfill are not very soluble. Thus, they may not migrate significantly from the soil into the water. Although radiation has been detected in some perimeter monitoring wells, the results have been inconsistant from the various sampling rounds and additional sampling is required to confirm the presence and magnitude of any contamination. Off-site ground water samples have not shown alpha or beta activity above the National Interim Primary Drinking Water Regulations (NIPDWR) levels of 15 pCi/l and 50 pCi/l, respectively.

Sampling for priority pollutants, including heavy metals and organics, showed no consistent pattern of on-site ground water contamination that could be contributed to the landfill. DOH off-site sampling and analysis of private well water revealed no detectable levels of pesticides, but the analysis did not include volatile organic compounds (VOC's) or metals.

Radioactive material at or near the surface of the west berm apparently has not eroded from the site because no material was detected off-site or in vegetation in 1981 data.

Radon gas is diffusing into the air above the contaminated areas, with maximum levels (1981 data) approximately equal to the NRC alternate concentration levels allowable for unrestricted areas. Current levels are unknown and levels are expected to increase in the future as the material seeks equilibrium. The potentially exposed population consists of the site work force whose presence in contaminated areas is believed to be brief and intermittent, reducing the cumulative exposure. No warning placards were present in the March 1990 site visit to indicate the radioactive contaminated area and to prevent inadvertent exposure. Earlier off-site sampling for radon did not reveal levels indicating any increased air concentration.

The health outcome data evaluation was inconclusive. The study population was much larger than those expected to be affected by the site. Community concern seems minimal, and is being adequately addressed by the DOH well water sampling and analysis program. Current sampling data is needed to better evaluate the levels of contamination in the ground water, soil, and air. Appropriate surveys need to be done both on and off-site so present pathways, potential exposure, and health effects can be determined.

RECOMMENDATIONS

It is recommended that at the earliest possible date a comprehensive Remedial Investigation/Feasible Study (RI/FS) be completed for the West Lake Landfill. It should include at least:

a. On- and off-site ground water monitoring for radiation and other contaminants;

b. On- and off-site soil sampling (surface and sub-surface) and determination of air radiation levels;

c. A complete survey of area wells and monitoring for landfill contaminants;

d. Proposal and implementation of a remedial action to prevent present and future exposure to workers and the public, if deemed necessary by the RI/FS.

During the community interview phase of the Remedial Investigation, information should also be gathered on former workers who were involved with the site during the transport, dumping, and spreading of radioactively

contaminated soil. The workers could then be encouraged to talk to public health officials at public meetings or availability sessions, or be personally interviewed at their homes in order to determine their past exposures, site related common health problems, and environmental circumstances during that time. The DOH will work with the EPA and MDNR to address this issue.

At the earliest possible date, a placard system identifying the radioactive areas must be installed in order to prevent inadvertent exposure. It is also recommended that DOH continue to expand its monitoring of area wells in order to include metals and VOC's associated with the landfill.

When additional data, i.e., the RI/FS, become available, such material will form the basis for further assessment by DOH/ATSDR at a later date.

FOLLOW-UP STATEMENT

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, the West Lake Landfill NPL site has been evaluated for follow-up health activities. There are no indications that the surrounding community is or has been exposed to site contaminants. Although worker exposure to site contaminants may have occurred in the past during the period of contaminated soil dumping, spreading and covering operations, it is believed that the exposure most likely did not occur at levels deserving of public health concern. Considering the available information, the site is not being considered for follow-up health activities at this time. Should the Remedial Investigation discover new evidence indicating actual or potential exposure of the public to site contaminants, DOH/ATSDR will reevaluate this site for follow-up health activities.

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CERTIFICATION

This health assessment was prepared by the Missouri Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was initiated.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health assessment and concurs with its findings.

Director, DHAC, ATSDR

REFERENCES

1. Berlin, M. and Rudell, B.; "Uranium" in Handbook on the Toxicology of Metals, edited by L. Friberg et al. Elsevier/North-Holland Biomedical Press, 1979

2. Burns & McDonnell. Hydrogeologic Investigation, West Lake Landfill Primary Phase Report. Kansas City, MO. October 1986. Project No. 84-075-4-004.

3. 10 CFR Part 20, App. B Concentrations in Air and Water Above Natural Background

4. Casarett and Doull's Toxicology: The Basic Science of Poisons, 3rd Ed. edited by Curtis D. Klaassen, Mary O. Amdur, and John Doull, Macmillan, NY, NY, 1986

5. Harley, N.H.; "Environmental Lung Cancer Risk From Radon Daughter Exposure" in The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies, Dennis J. Paustenbach, ed., John Wiley & Sons, NY, NY, 1989

6. Missouri Department of Health. Cancer Registry and Natality Data Analysis. West Lake Landfill, Bridgeton, Missouri. 1990.

7. Missouri Department of Health. Private Well Sampling Data, West Lake Landfill, Bridgeton, Missouri. 1989.

8. National Research Council, Committee on the Biological Effects of Ionizing Radiation (BEIR). 1988. Health Risks of RADON and Other Internally Deposited Alpha-Emitters. Washington, DC: National Academy Press.

9. Review of copies of EPA Form 8900-1, Notification of Hazardous Waste Site, required by CERCLA 103(c). Missouri Department of Natural Resources Site file, 1990.

10. Schroff, C. and Steinberg, R.E.; RCRA and Superfund - A Practice Guide with Forms. Garland Law Publishing, New York, New York. 1989.

11. U.S. Nuclear Regulatory Commission. Office of Nuclear Material Safety and Safeguards. Site Characterization and Remedial Action Concepts for the West Lake Landfill. Docket No. 40-8801. July 1989.

12. U.S. Nuclear Regulatory Commission. Office of Nuclear Material Safety and Safeguards. Radioactive Material in the West Lake Landfill. NUREG-1308 Rev. 1 June 1988

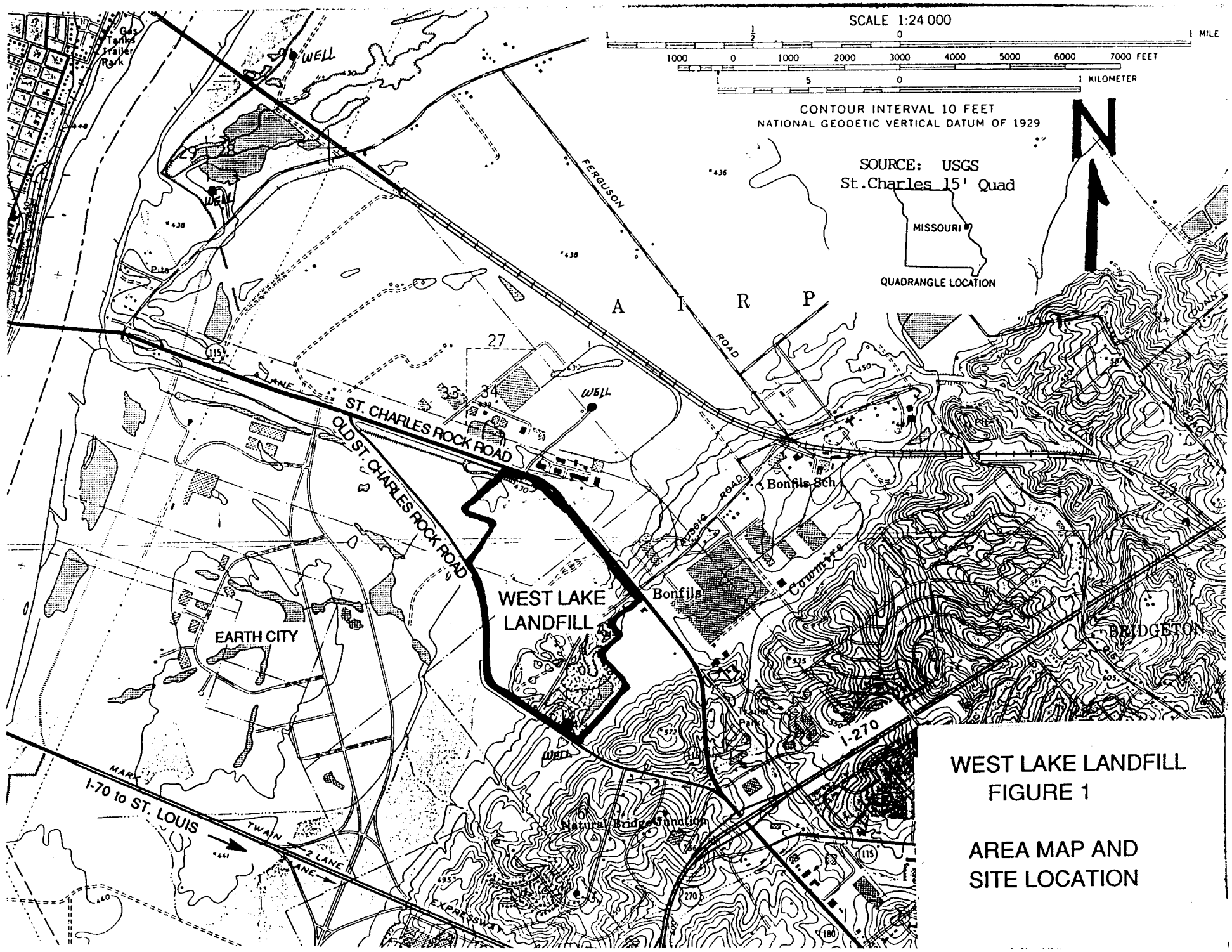
13. U.S. Nuclear Regulatory Commission. Office of Nuclear Material Safety and Safeguards. Radiological Survey of the West Lake Landfill. St. Louis County, Missouri. NUREG/CR-2722. May 1982.

APPENDIX

Figure 1. West Lake Landfill Area Map and Site Location

Figure 2. West Lake Landfill External Gamma Radiation Levels Map May, 1981.

Figure 3. Missouri Health Outcome Data Census Tract Location Map



WEST LAKE LANDFILL
FIGURE 1

AREA MAP AND
SITE LOCATION

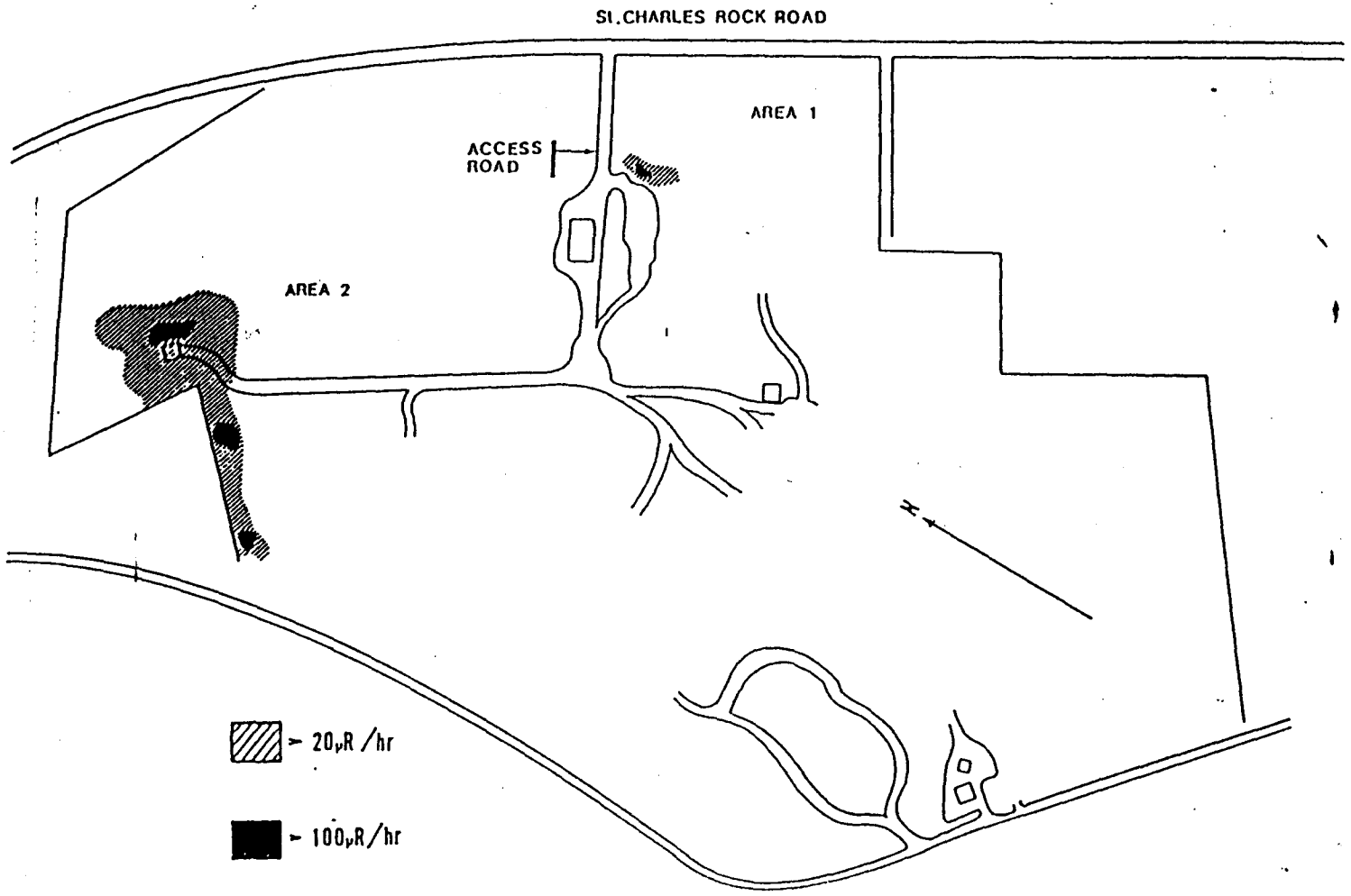


Figure 2 External gamma radiation levels, May, 1981

SOURCE: NRC, Radiological Survey of the Westlake Landfill, St. Louis Co., MO 1982

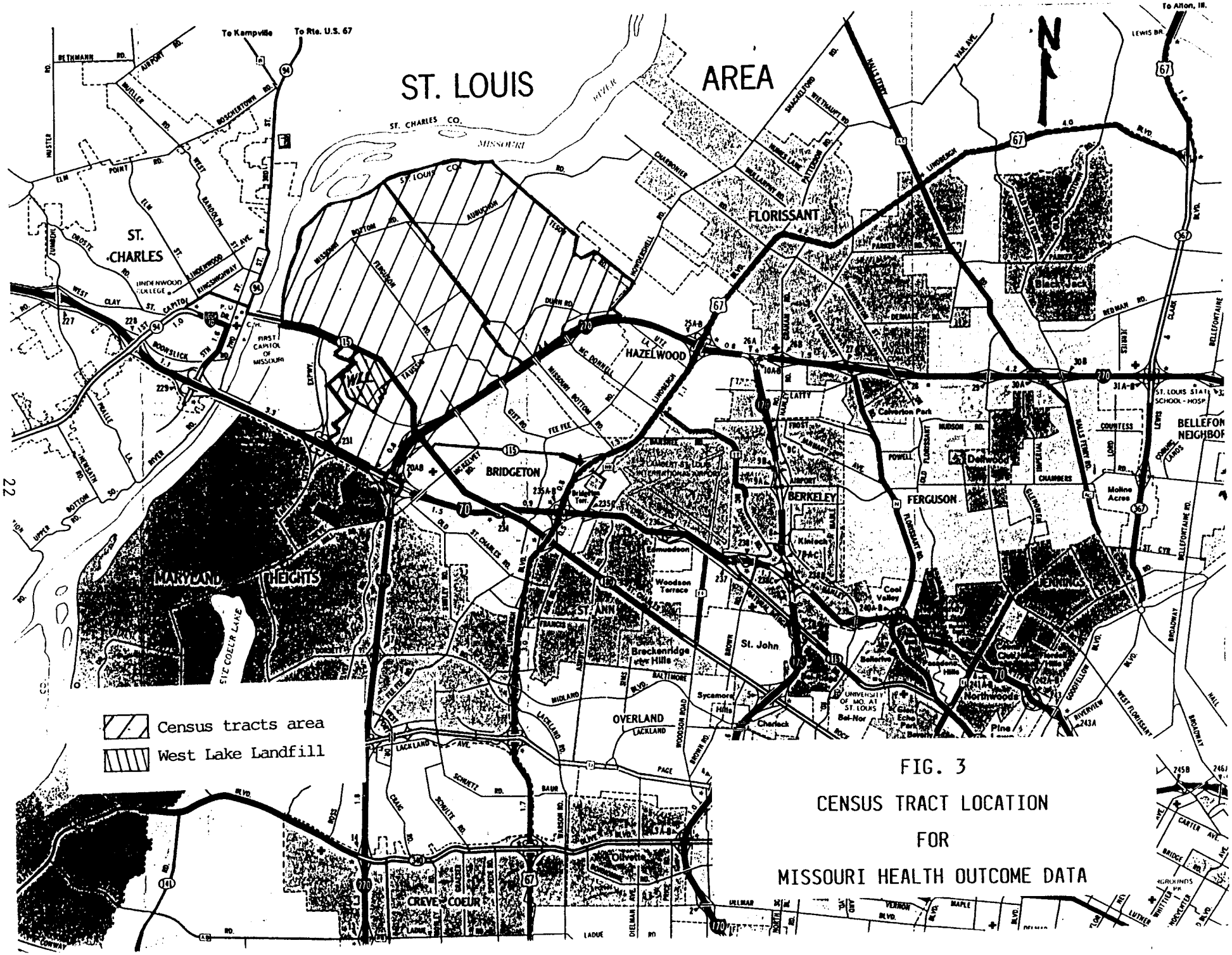


FIG. 3

CENSUS TRACT LOCATION

FOR

MISSOURI HEALTH OUTCOME DATA